Multifaceted processes controlling the distribution of hazardous compounds in the spontaneous combustion of coal and the effect of these compounds on human health

Marcos Leandro Silva Oliveira, Katia Da Boit Martinello, Fernanda Pacheco, Elba Calesso Teixeira, Ismael Luis Schneider, Tito Jose Crissien Borrero, Diana Del Carmen Pinto Osorio, Rafael Fernando Oyaga Martinez, Luis Felipe Silva Oliveiva

Abstract

Pollution generated by hazardous elements and persistent organic compounds that affect coal fire is a major environmental concern because of its toxic nature, persistence, and potential risk to human health. The coal mining activities are growing in the state of Santa Catarina in Brazil, thus the collateral impacts on the health and economy are yet to be analyzed. In addition, the environment is also enduring the collateral damage as the waste materials directly influence the coal by-products applied in civil constructions. This study was aimed to establish the relationships between the composition, morphology, and structural characteristics of ultrafine particles emitted by coal mine fires. In Brazil, the self-combustions produced by Al–Ca–Fe–Mg–Si coal spheres are rich in chalcophile elements (As, Cd, Cu, Hg, Pb, Sb, Se, Sn, and Zn), lithophile elements (Ce, Hf, In, La, Th, and U), and siderophile elements (Co, Cr, Mo, Fe, Ni, and V). The relationship between nanomineralogy and the production of hazardous elements as analyzed by advanced methods for the geochemical analysis of different materials were also delineated. The information obtained by the mineral substance analysis may provide a better idea for the understanding of coal-fire development and assessing the response of particular coal in different combustion processes.

Keywords:

Advanced characterization, Al–Ca–Fe–Mg–Si spheres, Coal fire, Complex structure, Mineralogy